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TWO DANGEROUS IMPORTED PLANT DISEASES.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., January 30, 1912.

Sir: I have the honor to transmit for publication a paper showing the imminent danger to American agriculture and forestry from two foreign fungous plant diseases which are transmitted in imported plant material. These two diseases, the one threatening the successful future of one of our most valuable forest trees and the other apparently one of the worst enemies of our great food crop, the potato, have already reached North America. The former has been widely distributed in this country but has not become established, while the latter has not yet been found in the United States. Neither in certain stages can be detected by inspection, and the only method of preventing their ultimate permanent establishment in the United States is national control of importations of the host plants. The danger from such diseases is continual and is increasing with the extension of rapid transportation facilities. National control of importations of plant material is necessary for adequate and prompt action in such emergencies as the present one, which are certain to recur more or less frequently.

The lack of national power and of adequate State laws makes necessary the prompt and wide distribution of these accounts of the white-pine blister rust and the potato wart disease.

I recommend the publication of this paper as a Farmers' Bulletin.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction	5
The white-pine blister rust	5
Life history of the white-pine blister rust	6
Economic importance of the disease	6
Plants affected by the white-pine blister rust	9
Field characters of the disease	10
Distribution of the white-pine blister rust	12
Source of diseased white-pine stock found in America	12
The situation in America	12
Methods of combating the disease	13
Practical suggestions regarding the white-pine blister rust	15
Danger to all American five-leaved pines	15
The disease expected to be worse in America than in Europe	15
Estimates of possible damage	16
Actual cost of imported white-pine stock	16
Why inspection for this disease is inefficient	17
Why no nursery can be given a clean bill of health	17
Prevention always easier and cheaper than cure	18
The work of eradication must be done by the States	18
Caution to general nurserymen	18
National power needed	19
The wart disease of the potato	19
Description of the wart disease	20
Life history of the wart organism	21
Means of distribution of the wart disease	22
Control of the wart disease	23
Distribution of the wart disease	23
Damage in England	24
Means of exclusion	24
Present method of inspection for insects entirely inadequate when applied to fungous plant diseases	26
Summary	29

ILLUSTRATIONS.

	Page.
FIG. 1. Young white-pine tree with swelling caused by blister rust	7
2. Potato wart	20
3. Potatoes cut in half, showing the wart disease	21

B. P. I.—725.

TWO DANGEROUS IMPORTED PLANT DISEASES.

INTRODUCTION.

Within the past few years two very serious European plant diseases have been brought to North America upon imported plant material. These diseases are of more than ordinary economic importance to us, as one is apparently the worst enemy of the white pine in Europe, while the other is practically certain to become one of the worst enemies of the potato wherever it occurs. They are especially serious because both have stages of development in which they can not be detected by inspection. The white-pine blister rust has been brought to this country in several million young white-pine trees, some of which are known to have been in the country a number of years before the presence of the disease became known. The importations already made have been carefully inspected and the diseased trees removed so far as possible. So far as now known the disease has not yet spread and become established here. The continued irresponsible importation of diseased white-pine trees renders it imperative that importation be regulated to some extent. The fact that neither disease can be detected by inspectors except in its most evident stages of development seems to make necessary some national quarantine power over plant material similar to that now in force for animals.

THE WHITE-PINE BLISTER RUST.

The white-pine blister rust (*Peridermium strobi* Klebahn) recently extensively brought into America is a fungus which is native in Europe. It first occurred there upon the stone pine (*Pinus cembra* L.), which is also a native of Europe. The fungus belongs to the rusts, of which the wheat rust is a well-known representative. Like the wheat rust, the white-pine blister rust has two entirely different hosts. These are the five-leaved pines for one stage of growth and currants and gooseberries (*Ribes* spp.) for the other stage. The two stages went by different names and for a long time were supposed to be two distinct fungi, but experiments have shown that the one when sown on its proper host plant will produce the other, and vice versa.

Note.—A list giving the titles of all Farmers' Bulletins available for distribution will be sent free upon application to a Member of Congress or the Secretary of Agriculture.

LIFE HISTORY OF THE WHITE-PINE BLISTER RUST.

The life cycle of the blister rust is as follows: The winter spores are blown from the currant and gooseberry leaves upon which they are produced to various parts of the white pines in the vicinity. There they stick to the bark of the young trees or branches and germinate. The branching threads of the fungus penetrate the inner bark tissues for some distance, but cause no external sign of disease until nearly a year after the time of infection. This period of incubation, so called, varies from one to several years, after which time the bark tissues commence to thicken perceptibly, giving the first visible signs of the disease. This thickening progresses rather rapidly for a few months until the bark is several times its normal thickness. The swelling is usually of a spindle shape, commonly tapering upward, but also in the reverse direction in some cases (fig. 1). Sometimes the swelling extends the length of an entire year's growth. In such cases wartlike bunches are scattered over the swollen part, the entire diseased portion having a peculiar obese apearance. Early in the spring, after the swelling has become noticeable, the fruiting bodies are formed in one or more places, bursting forth from the inner bark tissues and setting free the yellow spring spores. This is the most conspicuous stage in the disease, but lasts only from the middle of April to the middle of June. During this time the inspection of diseased trees should be made. These spring spores are blown about and fall upon the newly developed leaves of any currants or gooseberries that may be in the vicinity. Here they germinate and infect the leaves. In 12 days or more new fruits are formed in tiny orange pustules which break forth on the lower side of the diseased leaves. The summer spores therein produced in turn infect other currant and gooseberry leaves, producing more summer spores in about two weeks' time. Thus the disease spreads rapidly on the currant or gooseberry leaves. After a month and a half or longer, slender hornlike outgrowths are produced in some of the pustules. These in turn produce the winter spores, which are capable of infecting young white-pine stems and branches.

ECONOMIC IMPORTANCE OF THE DISEASE.

The stage of the disease upon currants and gooseberries is usually the most abundant and conspicuous, but the actual damage is not great. Badly diseased leaves are shed prematurely and the bush is more or less weakened. Instances are known where the bushes have died from the effects of the disease, but this is not common. The fungus is not known to live over winter on Ribes, but its occurrence in some cases seems to indicate that it may attack bud scales or young twigs and possibly be shipped thus on dormant cuttings from one country to another.

The stage on pines is the one in which the greater damage is done. The fungus lives in the bark of the host, forming new fruits each spring until the tree dies. It is sure to kill the affected trees, since if the tree survives until it is 25 to 30 years old it is relatively weak at

FIG. 1.—Young white-pine tree with swelling caused by blister rust.

the point of attack and ultimately breaks over in some heavy wind Most of the attacked trees die the first season that the fungus fruits. However, there may be a small number which survive until the next spring and bear a new crop of spores. Each year the number decreases

until the disease finally dies out *if there are no Ribes near enough to become affected.* The great damage is caused by the dying of the young pine trees in nurseries, plantations, and parks and those naturally reproduced in the forests. Old trees may be attacked, but only on their younger twigs and branches. Trees 100 years old have been killed, but such cases are not common. The use of white pine has been discontinued in Denmark and Holland and is largely given up in England because of this disease. In Europe the loss has in numerous cases ranged from 15 to 100 per cent of the original stand.

Many more or less definite statements have been found of the occurrence of this fungus in European nurseries, but in most cases the nursery is not definitely named. The following German nurseries have had the disease at approximately the indicated dates: J. Heins's Sons, Halstenbek, 1903–1911; Späth, Berlin, 1887–1895; H. C. A. Helleman, Moorende (near Lilienthal), 1886–1887; Metz & Co., Steglitz (near Berlin), 1887–1889); H. H. Pein, Halstenbek, 1905–1907. The French firms of Levavasseur & Son, Ussy, Barbier & Co., Orleans, and E. T. Dickinson, Chatenay, have recently shipped diseased trees into this country. Less definite statements show that the disease has occurred in nurseries at the following places: *Germany:* Berlin, Muskau, Eberswalde, Amelsbüren, Delmenhorst, Tharandt, and Mühlenbek. *France:* Paris. *Sweden:* Stockholm. *Russia:* St. Petersburg.

Neger and Von Tubeuf mention this disease as the most destructive one occurring upon white pine in Germany. Griffon and Maublanc state that it caused much damage in 1908 in the forest of Fontenoy, France, and Pechon also mentions it as destructive in the forests of Ardennes, France. Ritzema Bos states that the disease has become so prevalent in Holland that the culture of white pine has been given up. A few years ago discrimination was shown in Europe against white-pine stock raised in Halstenbek, Germany, because of the blister rust. Ravn has recently stated that this disease alone is responsible for discontinuing the use of white pine in Denmark as a forest tree, as the tree is otherwise very successful there. Somerville says "that the outlook in this country [England] for the Weymouth (white) and other five-leaved American pines is almost hopeless. * * * But it is to be feared that the day is not far distant when it [the white-pine blister rust] will gain a footing in North America, and if it spreads there, as it has done in Europe, the loss that will result through the destruction of one of America's most valuable lumber trees can only be described as appalling."

Many other statements regarding the serious nature of this disease will be found in Bulletin 206 of the Bureau of Plant Industry, entitled "The Blister Rust of White Pine."

PLANTS AFFECTED BY THE WHITE-PINE BLISTER RUST.

The fungus which causes the white-pine blister rust is not limited to a single host species in either stage. In the spring form (*Peridermium strobi*) upon pines it evidently first occurred native in the Ural Mountains and Alps upon the European stone pine (*Pinus cembra* L.). About 200 years ago the white pine (*Pinus strobus*) was introduced from America into Europe and within the last century has been extensively planted in European forests. About 50 years ago the blister rust was found attacking the white pine in Europe. Since that time the disease has been found in Europe also upon the sugar pine (*Pinus lambertiana* Douglas), the western white pine (*P. monticola* Douglas), and probably the Himalayan white pine (*P. excelsa* Wall.). All these host pines are very closely related to each other and all belong to the five-leaved group. There are 18 different five-leaved species, which are found in different regions of the world. Of these 18 species which are liable to attack, North America has exactly one-half, or 9 species. The following table gives these species, with their native ranges:

THE NORTH AMERICAN FIVE-LEAVED PINES.

Common name.	Scientific name.	Range.
1. Mexican white pine	*Pinus ayacahuite* Ehrenb.	Southern Mexico into Guatemala.
2. Hook pine	*P. strobiformis* Engelm.	Southern Arizona into Chihuahua, Mexico.
3. Limber pine	*P. flexilis* James	Rocky Mountain region.
4. White-bark pine	*P. albicaulis* Engelm.	British Columbia, Alberta, and Montana to Wyoming, Washington, Oregon, and southern California.
5. Foxtail pine	*P. balfouriana* Murray	California.
6. Bristle-cone pine	*P. aristata* Engelm.	High peaks from Colorado to southern Utah, Nevada, southern California, and northern Arizona.
7. White pine	*P. strobus* L.	Newfoundland to Pennsylvania, along the Appalachians to Georgia, west to eastern Iowa and Minnesota; in Canada from Lake Winnipeg to the northern shore of St. Lawrence Gulf and Newfoundland.
8. Western white pine	*P. monticola* Douglas	Montana and southern British Columbia to Washington, Oregon, and California.
9. Sugar pine	*P. lambertiana* Douglas	Oregon through California to Lower California, Mexico.

THE FOREIGN FIVE-LEAVED PINES.

Common name.	Scientific name.	Range.
10. Himalayan white pine	*Pinus excelsa* Wall	Himalaya Mountain region.
11. Roumelian white pine	*P. peuce* Gris	Montenegro, Bulgaria, and Balkan Mountains.
12. Chinese white pine	*P. scipioniformis* Mast	Central China.
13. Japanese white pine	*P. pentaphylla* Mayr	Japan.
14. Korean pine	*P. koraiensis* Sieb. and Zucc	Japan, Chosen (Korea), Kamchatka, Manchuria, western China, and Formosa.
15. Creeping pine	*P. pumila* Rgl	Northeastern Siberia and Japan.
16. Small-flower pine	*P. parviflora* Sieb. and Zucc	Japan.
17. Armand's pine	*P. armandii* Franch	China.
18. Stone pine	*P. cembra* L	Alps, Karpathian and Ural Mountains, northern Russia, and Siberia.

In the alternate stage the fungus causing the white-pine blister rust attacks the leaves of currants and gooseberries. A few species are partially but not wholly immune to the fungus, so that we must at present consider all species susceptible and dangerous when in the vicinity of white pines *if either is affected with the disease*. There are about 50 different species of currants and gooseberries in the world; of these, 26 have been found infected by the fungus, but it is probable that all of them may be susceptible to the disease.

FIELD CHARACTERS OF THE DISEASE.

No 1-year-old or 2-year-old trees have been seen which showed the blister rust, and the senior writer believes that such trees never or very rarely have the disease. Diseased trees are often peculiarly stunted in appearance, the top having a compact, bunchy growth, not branching freely, as the white pine normally does. This is so characteristic that the diseased trees can often be picked out from among their healthy companions by it alone. The new growth of the last season is often shorter than in healthy trees. In badly diseased trees which have had the disease two or more years there may be orange-yellow spots upon the new wood and on the new needles. This is not commonly seen, however.

The stem of a healthy young white pine has practically a uniform diameter through each year's growth. Trees visibly affected with the blister rust usually have a more or less marked swelling where the first whorl of branches is given off from the main stem. This swelling usually tapers gradually for several inches, either upward or downward from the whorl of branches (fig. 1). In some few cases

the stem (in 3-year-old trees) is swollen irregularly its entire length and has a very characteristic obese appearance. Scattered at intervals are often numerous wartlike bunches, located at leaf scars. Sometimes the swelling extends outward into the branches. These swellings may be distinguished from those caused by other organisms by splitting an affected stem, when it will be found that the wood retains a nearly uniform diameter even in badly swollen stems. The swelling is caused by an abnormal growth of the bark, so that the latter is often two or three times its normal thickness.

Rather rarely one finds cases where the bark has died in a ring around the stem without any swelling. These have been attributed to this disease also, as they have never been seen except in lots of trees which were known to be diseased and as similar effects are known to be caused by other species of blister rust.

Older trees (5 to 10 years) do not show the stunting and may not show the swelling markedly, but they have (at the affected place) an abnormally thick, scaly bark. Normally, the white pine does not form scaly bark on wood that is less than 10 to 15 years old.

The most certain symptoms of this disease are the fruiting bodies of the fungus. These show first as rounded yellowish white pustules pushing out through crevices in the bark. These pustules are rounded to elongate in outline, one-fourth to one-half inch by one-eighth to one-fourth inch. At first the bark breaks open and a rounded mass of an orange color pushes through the fissure. This attains a height of one-eighth to one-fourth inch and breaks open irregularly, allowing the powdery, orange-colored contents (spores) to escape. After the spores are given off, a delicate whitish membrane is left standing upright around the edges of the fissure and projecting somewhat from it. Still later this also disappears and one finds only an empty depression in the bark, with more or less rounded outlines and with some whitish masses of material in the rough bottom which upon microscopic examination prove to be masses of spores. These empty fissures are so characteristic that they may be easily recognized at once, even by the unaided eye. The yellow pustules, either before opening or after, are also very characteristic and are usually to be found between the last of April and the middle of June; the whitish membrane may be found at any time after June 1 up to late autumn; the empty fissures where the spores were earlier produced may be found at any time after June 1. Many times trees are found which have the swollen stem, but no spores or traces of pustules. These can usually be distinguished from trees affected by any other form of injury. An abrasion of the bark usually results in the formation of a swelling around the edges of the wound, but this can easily be distinguished from the swollen condition caused by the white-pine blister rust.

DISTRIBUTION OF THE WHITE-PINE BLISTER RUST.

An effort has been made to determine accurately the distribution of this fungus in Europe in the hope of finding some country or some region from which it is absent and consequently from which white pines may be safely imported. It has been reported from practically all Europe except the Balkan and Spanish peninsulas. It is prevalent in all the important countries of Europe exporting forest-nursery stock, and its prevalence in a district seems to increase with the extension of the forest-nursery interests. It is also reported from several localities in western Siberia, from Japan, from Sakhalin Island, and possibly from the Himalaya Mountains. In America there are known to be more than 230 localities where this disease has been found on imported trees.

SOURCE OF DISEASED WHITE-PINE STOCK FOUND IN AMERICA.

Every lot of white-pine stock diseased with the blister rust which was found in 1909 was traced directly to the nurseries of J. Heins's Sons, Halstenbek, Germany. This included a total of more than 220 separate lots which had been planted out by individuals. In the spring of 1909 this firm shipped to the United States approximately 2,500,000 white pines which were 2 and 3 years old, while since 1900 this firm has shipped to eastern North America over 4,500,000 of such trees. It is reasonable to believe that at least half as many more have been sent to other sections of this country. Our finding diseased trees, purchased from this firm, which have been in the country from one to six or seven years shows that their nurseries have been seriously infected all this time and that there is danger from every shipment of white pines which has been received from them. In 1910 only a few shipments are known to have been sent to this country by J. Heins's Sons and the same is true of 1911. In 1910 lots of white pines diseased with blister rust were received in this country from the three French firms of Levavasseur & Son, of Ussy; Barbier & Co., of Orleans; and E. T. Dickinson, of Chatenay. In 1911 a lot of white pines was received from J. Heins's Sons which bore mature fruiting bodies of the blister-rust fungus when they were unpacked. Some diseased trees were also received from an unknown French firm.

THE SITUATION IN AMERICA.

In 1909 it was discovered that the blister rust had been shipped into New York on 2-year-old white pines from Germany in the spring of 1908. Further investigation showed that it also was present on 3-year-old trees which had just been received from Germany and which had been sent from the same nursery to the States of New York, Vermont, New Hampshire, Massachusetts, Connecticut, Penn-

sylvania, and Minnesota. As soon as the presence of the disease was definitely determined, the New York authorities called a meeting of the representatives of forestry interests then known to be concerned or likely to be involved. At this meeting the State officials agreed to begin at once the removal of currants and gooseberries from the vinicity of the plantations of diseased trees in their States and to remove and burn all the trees which showed traces of the disease. Considering the difficult nature of the work it was done in a short time, but none too quickly, as was shown by the discovery of a single instance where the fungus had spread from the diseased imported pines to currants near by. The spores, however, were still inclosed beneath the epidermis of the currant leaves and had not yet been set free. So the disease was checked in the nick of time. Each spring the diseased white pines have been inspected and the diseased trees destroyed.

In 1910 white-pine trees affected with the blister rust were found by the State horticultural inspector in two different places in Ohio. In 1911 another lot of diseased trees was found in a third locality.

In Indiana a single diseased lot of white pines was reported as having been found in the State in 1910. This lot was promptly destroyed.

In Virginia the senior writer found the disease present in a shipment of white pines which had been sent to the State in 1911.

In New Jersey a single shipment of white pines which had been planted out the year before was found by the senior writer to have the blister rust. The owners promptly pulled them up and burned them.

In the spring of 1909 a very large lot of young white pines was received in Ontario, Canada, from the same nursery as those which were found diseased in this country.

The prompt action of the State officials in eradicating the disease as far as possible has, so far as now known, prevented the fungus from becoming established in this country. There are, however, undoubtedly other scattering lots of diseased trees which have been imported at various times. Information concerning these should be sent as promptly as possible to the proper State authorities or to the Bureau of Plant Industry, so that proper action may be taken before the disease becomes established.

METHODS OF COMBATING THE DISEASE.

American nurserymen have one effective method of combating this disease, i. e., to stop importing European stock of any of the five-leaved species of pine. A nurseryman who does this and who allows no Ribes to grow near his nurseries need have no fear of the blister

rust. In places where the disease is already present, the only course is to remove the least valuable of the two hosts and destroy all diseased plants of the remaining host. Two or three inspections in July and August at intervals of 10 days to two weeks should make sure of all infected currants and gooseberries if the diseased and suspected ones are each time destroyed when found. In an infected lot of pines, inspections made during the month of May for several consecutive years should be sufficient, provided all suspicious trees are at once burned. In the case of an infected plantation or nursery of pines all wild and cultivated currants and gooseberries should be promptly removed to a distance of 300 to 500 feet from the edge of the area containing the pines. The pines should be very carefully inspected and all trees which show the least signs of this disease should be burned at once. Another inspection the following spring should result in the removal of those infected trees which were not detected the first time. Owing to the indefinite period of incubation of the fungus it is improbable that a single inspection will result in the removal of all the infected trees. All white-pine trees imported before they are 3 years old should be inspected when they reach that age, as the disease apparently does not become visible on younger trees. It is advisable that imported trees be held in nursery rows for at least one year, to determine beyond a doubt whether the disease is present or not. Any person buying young five-leaved pine trees should require the seller to guarantee the stock to be free from this disease, or, better, to have been raised from the seed in America, since any foreign stock is liable to be diseased. Those persons who insist upon importing white-pine stock will endanger their neighbors and the entire country in spite of the most rigid inspection that can be made. Foreign seed will not carry this fungus and is perfectly safe so far as the blister rust is concerned. The Office of Investigations in Forest Pathology of the Bureau of Plant Industry will teach inspectors the characters of the disease and so far as possible will make inspections where there are no State inspectors or where local inspectors are unable to do so. Specimens of white-pine trees or of Ribes leaves will be promptly examined and the results reported, with suitable recommendations for treatment. The Bureau of Plant Industry would also recommend that shipments of imported trees be reported to it, together with the name of the nursery or firm from which obtained. This will enable it to take prompt action in notifying owners of new developments in regard to treatment, etc.

PRACTICAL SUGGESTIONS REGARDING THE WHITE-PINE BLISTER RUST.

Danger to All American Five-Leaved Pines.

In the white-pine blister rust we have the very peculiar case of a foreign disease attacking an American tree in Europe and being brought on imported white pines to America with great danger to our native forests of this and other closely related species of trees. The disease has been known in Europe for about fifty years. It has not caused great damage to its original pine host, while its attacks on the American white pine continue with all their original severity and the disease is becoming more and more prevalent throughout Europe. Besides the eastern white pine of North America the disease has attacked two of the western American white pines. It has had many chances in Europe to attack pines which do not belong to the white-pine group, but has never yet been found upon any of them. It has shown a decided preference for the five-leaved or white pines and there seems to be danger of its attacking all of them. These pines occur naturally in the forests of this country except in the section extending from Texas and Oklahoma eastward and southward from the Ohio River. Even here the eastern white pine extends in the mountains as far south as northern Georgia and Alabama. Moreover, the Mexican and Himalayan white pines are commonly planted in this section as ornamentals and their use is increasing. Wild and cultivated currants and gooseberries are distributed throughout the country where any of the white pines naturally occur. It would be merely a question of time for the white-pine blister rust to spread over the country if it once became established.

The Disease Expected to Be Worse in America than in Europe.

A parasitic fungus newly introduced into a favorable climate or attacking new host species is likely to become more virulent and to cause greater and more complete destruction than before. Such a disease-producing fungus, when once established, is a permanent factor in the cultivation of its host plants. The histories of the potato blight, the grape mildew, the asparagus rust, the hollyhock rust, and many other parasitic fungi which have been carried from one continent to another prove the truth of these statements. In Europe the stone pine and the white pine are quite generally distributed, but none of the other known pine hosts of the blister rust are very generally distributed there. This practically limits the fungus to the above two species of pine in Europe. The stone pine is not usually seriously injured, while the American white pines are

very seriously attacked. So far as known all the American white pines are liable to attack. With the great variety of climatic conditions existing in various parts of America it will be surprising if this fungus does not find some section suited to its best development. There is every reason to expect this disease to be as bad as or worse than it now is in Europe if it once becomes established here.

Estimates of Possible Damage.

A very crude idea of the loss which this disease might cause may be obtained from the following statements concerning the white-pine interests of America. The products of the white pines for the year 1908 were valued at $65,000,000. If only 1 per cent of loss was caused per annum (a very conservative estimate), the loss would be $650,000. The standing white pine has been estimated as worth $600,000,000, while the sugar-pine stand was valued at $120,000,000. These would give losses (at 1 per cent) of $6,000,000 and $1,200,000, respectively. The smaller alone far exceeds the valuation of all the white-pine stock that has ever been imported into the country. Should the disease become as aggravated as it is in England the losses would greatly exceed 1 per cent on all sizes of trees. The plantations of white pine now in existence in New England have been estimated to yield 200,000,000 feet of lumber between 1930 and 1950. In New England white pine is used in about 90 per cent of all the planting done. Fragmentary reports show that over 13,000 acres of land have been planted in the States of New Hampshire, Vermont, New York, Pennsylvania, New Jersey, Massachusetts, Connecticut, and Rhode Island with this one species. In the single year 1909 about 3,000 acres were planted in New York, Vermont, New Hampshire, Massachusetts, and Connecticut. This really important planting movement will be greatly checked, if not entirely eliminated, by this disease if it becomes established. The addition of this to its already heavy burden of difficulties will be fatal at the very moment the movement bids fair to accomplish results commensurate with our needs.

Actual Cost of Imported White-Pine Stock.

The original relatively low cost of European white-pine stock gives this an apparent advantage over American-grown stock. When to the original cost is added the higher expense of packages and the ocean freight, the apparent advantage in favor of European stock very largely disappears. While European stock as a rule compares favorably with American stock, there should be no advantage of the one over the other. It is possible to raise just as good stock here as in Europe. The risk of having the stock damaged by the long ocean

voyage and the danger of importing destructive insect pests and fungous diseases which may soon cause far more damage than the entire value of the imported stock will deter any but the most venturesome from undertaking the importation of white-pine stock for the purpose of lessening expense. Moreover, American nurseries are now enlarging their output of such stock and one large nursery has reduced its prices until they compare very favorably with those in Europe.

Why Inspection for This Disease is Inefficient.

The blister rust vegetates in the bark tissues of pine for a number of months before any external signs of its presence are visible. This period of incubation is of uncertain length, but apparently varies from about one year to several years. During this time no inspection, however thorough, can detect the disease. A very good example of this is afforded by certain trees imported in 1908 when 2 years old, which the senior writer carefully examined at that time for this disease without finding the slightest signs of it. In 1909 they were visibly affected. The same thing has happened in others imported in 1909 when 2 years old. They now have the disease. Inspection can not detect affected trees except those which already have developed swellings or fruiting bodies. This is true of any single inspection which can be made. Repeated inspections are absolutely necessary in order to make sure that imported stock is free from disease. Such repeated inspections soon cost more than the value of the seedlings, to say nothing of the small saving between the cost of American and European stock.

Why No Nursery Can Be Given a Clean Bill of Health.

The giving of a clean bill of health to a nursery presents the same difficulties as inspection. An inspecting pathologist would need to know intimately the entire neighborhood surrounding the nursery; he would have to watch the nursery for at least two years, and in most cases longer, in order to be able to certify that this disease was not present. A single brief trip to Europe by an American pathologist could not possibly prove the absence of this disease in a single European nursery. On the other hand, it might prove its presence in some cases. The proposition would involve the residence in Europe of a pathologist who would spend most of his time in examining nurseries. Even this could not be conclusive unless the entire life history of the imported seedlings was known to him, or unless currants and gooseberries were found to be absent for a considerable distance around the nurseries.

Prevention Always Easier and Cheaper than Cure.

The essential feature of all plant-pathological work which has to do with combating disease is prevention rather than cure. This is necessarily so, since the nature of plants renders curative measures of very doubtful efficacy as a rule. If the disease can be prevented, the work is much more successful and satisfactory than when endeavors are made to stop a serious outbreak. This is preeminently the case with America and the white-pine blister rust. Comparatively small effort will keep it out, while no efforts likely to be exerted will stop it after it once becomes established here. The sooner the matter is taken in hand the cheaper it can be done. The situation in Europe is steadily growing worse so far as we are able to judge, and this would be the case in America should this disease obtain a secure foothold. The disease has been eradicated once in America and it can be done again and kept out of the country if the recommendations herein made are carried out.

The Work of Eradication Must Be Done by the States.

There are now no national laws in this country which apply to plant diseases. Hence the United States Department of Agriculture is without power to prohibit the importation of white-pine stock even if known to be diseased. This places all responsibility on the various State organizations. Some of the States have laws of some sort against serious plant diseases; those which have none should in self-defense pass them at once. The Office of Investigations in Forest Pathology of the Bureau of Plant Industry is ready to do all in its power, and to that end will instruct inspectors, make examination of material sent to it, and advise as to the best methods of combating the disease in specific instances. It has a limited supply of colored charts of this fungus which will be sent to applicants.

Caution to General Nurserymen.

Nurserymen who handle and grow any of the species of currants and gooseberries will do well to keep the white-pine blister rust in mind at all times. Its three appearances on Ribes in this country are utterly inexplicable and two of them may have been the result of importing new stock and varieties. Notwithstanding that it is supposed to attack only the leaves of Ribes, there is the possibility of its infecting buds or young wood and thus being carried on dormant bushes or cuttings. There is constant danger when Ribes or any five-leaved pine is imported from Europe, and the general nurseryman who imports either will but follow the dictates of simple prudence if he keeps currants and gooseberries well separated in his

grounds from the five-leaved pines of any species and if he inspects these bushes once in a while every summer for the fungus. Specimens of diseased leaves should be sent to the State agricultural experiment station or to the Office of Investigations in Forest Pathology of the Bureau of Plant Industry for identification of the fungus infesting them.

National Power Needed.

Because of the seriousness of the white-pine blister rust in Europe and the great danger to American forests if the disease becomes established here, it is imperative that adequate measures be taken at once to prevent such misfortune. The destruction of all visibly diseased trees now in this country is not enough, although this is nearly all that has thus far been possible. Some of the States are inspecting imported white-pine stock and have thus prevented the scattering of the disease in a number of visibly infected shipments. The fact remains that there is more or less irresponsible importation of such stock. This must be stopped. The only available method seems to be national control of the importation of white pine by giving the Secretary of Agriculture power to prohibit such importations from certain nurseries or localities until they clean out the disease from their premises. Moreover, the importation of five-leaved pines should be subject to permits from the Secretary of Agriculture, so that every shipment may be traced if necessary. These measures would give absolute control of the disease, and they are the only ones which will do so. Canada has already prohibited the importation of the disease and requires proper notice of all importations of plant material.

THE WART DISEASE OF THE POTATO.

Potatoes rank as one of the most important farm products in this country. The Yearbook of the United States Department of Agriculture for 1910 estimated the production of that year at 328,787,000 bushels. Only five other farm crops are valued above this, namely, corn, cotton, hay, wheat, and oats.

Consequently, much alarm is felt over the probable introduction of the potato wart. This is a comparatively new disease which was discovered on potatoes in Germany and Upper Hungary 16 years ago. Since that time it has spread with great rapidity and threatens to become one of the worst enemies of potato culture. It has not yet been brought into the United States so far as known, but has already crossed the Atlantic and become established in Newfoundland, where it was discovered by Dr. H. T. Güssow, Dominion Botanist. The close proximity of the disease to the United States makes it imperative that steps should be taken to guard against its importation.

DESCRIPTION OF THE WART DISEASE.

The wart disease is one which attacks the tubers principally, causing the formation of wrinkled, warty excrescences, which have given rise to the names "warty disease," "black scab," "canker," and "cauliflower disease." (Fig. 2.)

FIG. 2.—Potato wart. A plant of a diseased potato as it appears when dug, showing in the center a partially sound tuber covered with excrescences caused by the fungus at the base; also showing six malformed tubers adhering to the plant. (After Güssow.)

Since the tuber is the part of the plant chiefly affected, it is difficult to ascertain the presence of the disease until harvesting time. A bulletin issued by the Harper Adams Agricultural College, England, states that in the case of badly affected potatoes the tops remain green longer than those slightly or not at all affected. Infection may take place, however, in all the young tissues of the plant, the roots, underground stems, aerial stems, and even the leaves.

The organism *Chrysophlyctis endobiotica* Schilb., which is the cause of the disease, gains entrance into the tuber through the tender tissue at the eyes. In a mild attack the eyes first appear grayish, then turn brown, and finally black, while in a healthy tuber they are whitish or purplish in color. It is very difficult, if not impossible, to ascertain the presence of the disease in this stage. Such potatoes, when used as seed, prove to be the source of new

infections wherever planted. It is due to this failure to recognize the disease in its early stages that potato wart has spread with such rapidity.

In more advanced stages the disease is very apparent. One or more nodules, varying in size from that of a wrinkled pea to lumps as large or larger than the tuber itself, may be found. (Fig. 3.) These are green where they project from the ground and white below, turning as they grow old to dark brown or almost black. They have a wrinkled, coral-like appearance, much like the head of a cauliflower. "A still more advanced stage occurs when the fungus has utilized every particle of food stored in the tuber and has reduced it to a brownish black soft mass, giving off a very unpleasant, putrefactive odor." (See fig. 2.) Such potatoes can not be harvested whole. The black pulpy mass breaks up, liberating millions of sporangia (spore sacs) which live for years in the soil. These sporangia have

FIG. 3.—Potatoes cut in half, showing the wart disease. (After Güssow.)

been known to infect potato crops after an eight-year interval. So far as known, longer intervals have not been tested and it is possible that the fungus may live in the soil even longer than that.

LIFE HISTORY OF THE WART ORGANISM.

The organism causing the "wart disease" forms two kinds of sporangia—the summer sporangia and the winter, or resting, sporangia. The latter, which hibernate in the soil or on the tuber itself, germinate in the spring, freeing thousands of motile spores. These are capable of moving some little distance if moisture is present. If they come in contact with the eye of the potato they work their way into the delicate tissue in probably much the same way as does the organism which causes the clubroot of cabbage. The fungus

then passes from one cell to another, stimulating the surrounding cells to rapid growth and division, which results in the warty protuberances on the tuber. Meanwhile, during the summer the fungus rounds up in some of the host cells and forms thinner walled summer sporangia, which soon germinate, liberating thousands of spores. These are capable of infecting other tubers during the same season. Late in the summer and in the fall before harvest time the thicker walled resting sporangia are formed and serve the purpose of carrying the fungus over the winter to infect the crop of next year. These sporangia may retain their vitality in the soil for eight years, thus making starving out a tedious process when a field once becomes infected. This means that potatoes must not be planted again in the soil where the disease has been present for at least eight years and possibly even longer.

MEANS OF DISTRIBUTION OF THE WART DISEASE.

The chief means of distribution of the wart disease is through the use of apparently healthy or only slightly diseased seed coming from infected fields. Such seed entering an uninfected territory is the origin of a new center for distribution. The Harper Adams Agricultural College in a recent bulletin states a case of one consignment of such seed causing the spread of the disease over a district with a 5-mile radius.

Too much emphasis can not be laid on the danger of planting seed taken from areas known to be infected. The danger would be lessened if tubers could be sorted into two lots—one diseased and one not diseased. It is practically impossible to do this, as slightly infected tubers can not be detected even by the most rigid inspection. For this reason various countries have enacted laws prohibiting the importation of any potatoes from infected areas. The United States also should have the power (which it does not have now) of rejecting potatoes from infected districts before the disease makes its entrance and becomes established here.

When the disease once enters a district it is frequently spread to adjoining areas through the use of infected manure. Consequently, diseased tubers should never be fed to stock unless boiled, as the sporangia pass unharmed through the animal. Prof. E. S. Salmon, of the South-Eastern Agricultural College, England, quotes one instance showing the danger of infection by manure. "A certain dairy farmer got one of his fields very slightly infected, but failing to recognize the disease he fed the small and diseased potatoes to cattle. The next year half his potato field was dunged with manure from his own yard, half with artificial manure. The potatoes manured with his own yard manure were all so badly diseased that he lost four-fifths of his crop; the other half of his field was practically free. As

he was feeding his cattle last year in the same way and had turned them out on clover ley [field], he will also have infected a third field."[1]

Poultry and pigs which are allowed to roam over infected areas are another means by which the disease is carried from one field to another. Sporangia may also be carried on men's boots and tools which have not been thoroughly cleaned on coming from infected land.

CONTROL OF THE WART DISEASE.

Extensive experiments have been conducted in England with various fungicides and variety tests of potatoes. There seems to be a consensus of opinion that fungicides are not efficacious in controlling the disease. The following chemicals have been used on the soil with unsatisfactory results: Sulphur, soot, quicklime, ground lime, formalin, ferrous sulphate, calcium bisulphate, potassium bisulphite, calcium sulphite, sodium borate, potassium sulphid, copper sulphate, and lead acetate. Experiments were also conducted by sprinkling the sets before planting with sulphur, lime, lime and sulphur, soot, and soot and sulphur with equally unsatisfactory results.

Better results are claimed to have been obtained by testing different varieties of potatoes. A number of varieties have been found to be resistant in England, but one authority maintains that "all the best varieties of potatoes, i. e., all those most profitable to grow, are excluded as susceptible." He also states that one variety said to be immune is very susceptible to late-blight. None of these varieties are of commercial importance in the United States.

At present crop rotation is the best method of dealing with the disease. Unlike late-blight, which is checked some years by climatic conditions, the wart disease when once in the soil grows worse each year on land that is planted to potatoes. Since the fungus has been known to live in the soil for eight years, potatoes should not be planted in that soil during that period. Fortunately, so far as known the fungus attacks no other crop.

A vigorous effort should be made, if found in the United States, to eradicate the trouble. All infected tubers should be boiled or burned, and no more potatoes should be planted on that field for eight years. Stock should not be allowed to run over infected areas, and no part of any lot containing diseased potatoes should be used for seed purposes.

DISTRIBUTION OF THE WART DISEASE.

The wart disease was reported first in 1896 by Schilbersky from Upper Hungary. Since then it has been found in Westphalia, the Rhine provinces, and Silesia of Germany; in 1901 in England, where

[1] The Journal of the South-Eastern Agricultural College, Wye, Kent, England, no. 18, 1909, p. 296.

it has spread with great rapidity; and in Wales, Scotland, and Ireland. In 1909 Dr. Güssow reported it from Newfoundland. He also records its appearance in Scandinavia, France, and Italy.[1]

DAMAGE IN ENGLAND.

The disease has been more widespread and destructive in England than in any other country. Under the destructive insects and pests acts, the Board of Agriculture and Fisheries made inspections of various districts in which the wart disease was present in gardens and published their findings in their annual report for 1909–10. The seriousness of the disease in some of the districts may be noted from the following quotations:

Brereton.—J. L. has ¼ acre practically all spoilt.

Hammerwich.—T. C.: Very bad.

Walsall Wood.—H. C.: Disease on newly broken-up land.

Sutton Coldfield.—W. C.: Disease much worse than last year in spite of dressing both seed and ground with sulphur. W. H.: Potatoes in allotment entirely destroyed.

Trentham.—Thirty cases reported. J. T.: 75 per cent diseased. T. H.: Very bad; potatoes all one mass of disease. J. R.: Whole garden more or less affected except for one small patch on which no potatoes have been grown for 10 years. This is free.

Newstead.—S. I.: Not a clean root in 600-yard garden.

Ecclestone.—J. M.: Total yield, four-fifths of last year's yield.

From the above quotations it will be noted that in the worst cases from 75 per cent up to the entire crop was affected by the disease.

MEANS OF EXCLUSION.

At the present time the United States has no legislation that will prevent the importation of potatoes affected with wart. No quarantine is maintained against plant diseases, nor is the Secretary of Agriculture authorized to inspect or prevent the importation of potatoes known to be infected.

Recognizing the serious nature of the disease England made it a notifiable disease under the destructive insects and pest acts, 1877–1907. Under this act anyone failing to report the disease is liable to a fine of £10. The annual report of the Intelligence Division, Great Britain Board of Agriculture and Fisheries, for 1909–10, contains the following statement:

> The alarm caused by the rumors of the spread of the disease in England led several authorities abroad to impose regulations against potatoes from this country. It was at first proposed to prohibit importation altogether, but on a protest from the board being made the matter was reconsidered and new regulations were drafted which admitted potatoes accompanied by a certificate from the grower that the crop came from a farm on which no case of wart disease existed and by a further certificate from the board that no case of the disease had been reported from that neighborhood. These regulations were adopted by Malta, the Transvaal, the Orange River Colony, and, after a short period of total prohibition, by the Island of Guernsey. The other African col-

[1] A Serious Potato Disease Occurring in Newfoundland. Bulletin 63, Central Experimental Farm, Ottawa, Canada, p. 4.

nies adopted precautions that did not entail the issue of a certificate, and the Island of Jersey prohibited the importation of potatoes from Great Britain altogether.

Australia has probably the most stringent quarantine measures against the wart disease with the exception of the Island of Jersey, which prohibits importations of potatoes from Great Britain. In March, 1911, the Governor General decreed that all potatoes imported must be accompanied by a certificate stating that such potatoes are free from the diseases of late-blight and potato wart and also that they were grown at least 20 miles from any place known to have been infected within five years. After the potatoes are landed they are planted in quarantine and if on maturity they show no signs of the disease, they may then be distributed.[1]

The Department of Agriculture of Canada has been empowered to take such action as may be necessary to prevent the introduction or spread of injurious insects and plant diseases. It has already done so with the wart disease of potatoes. Quoting from the Gardeners' Chronicle:[2]

> The Minister of Agriculture has power to prohibit the importation of plants from any given region should it be deemed necessary, owing to the presence of serious insect pests or diseases in such a region. This has been done in the case of potatoes from Newfoundland and the neighboring islands to prevent the introduction of potato canker (*Chrysophlyctis endobiotica*).

At present the most effective protection against the importation of potatoes is the tariff of 25 cents a bushel. Yet in spite of this the following quantities have come to our markets from abroad:

TABLE 1.—*Importations of potatoes into the United States for 1907, 1908, and 1909, with their valuation.*

Country of origin.	1907		1908		1909	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Bushels.		*Bushels.*		*Bushels.*	
Austria-Hungary	741	$331	1,723	$746	1,331	$657
Belgium	75	84	6,889	3,650	260,932	109,609
Bermuda	87,045	135,569	80,711	109,561	139,590	176,345
Canada	11,393	5,970	177,102	80,006	1,181,693	549,029
Germany	39,119	19,934	62,059	38,368	79,024	44,373
Netherlands	5,704	2,184	38,892	18,109	74,697	26,352
Spain	7,730	7,408	11,246	11,596	9,144	7,333
United Kingdom:						
England	5,673	3,706	2,269	1,321	1,785,298	725,037
Scotland					2,684,588	1,099,858
Ireland					1,975,877	814,898
Other countries	19,134	17,399	23,061	19,615	191,792	123,483
Total	176,917	192,635	403,952	283,032	8,383,966	3,677,034

[1] In a later regulation issued July 24, 1911, subclause C of March 25, 1911, was withdrawn and potatoes, accompanied by an official certificate signed by a responsible officer stating that the potatoes were grown on premises known, after due investigation, not to be or to have been during the preceding 12 months infested with either wart disease or blight, might be permitted entry, and the growing of potatoes in quarantine for the first year was not required. On September 1 of the same year, Western Australia repealed the new conditions in so far as potatoes after being landed are to be grown for the first year in quarantine.

[2] Gardeners' Chronicle, vol. 50, 1911, p. 21.

Table I shows the large increase of potatoes exported in 1909 from Great Britain into the United States. This ranged from 5,673 bushels in 1907 to 6,445,763 bushels in 1909. It will also be noted that Great Britain, where the wart disease is most prevalent, exported in 1909 more than three times as many bushels into this country as all other countries combined.

The principal custom districts of potatoes in 1909 were as follows: Aroostook, Me., 152,406 bushels; Passamaquoddy, Me., 13,745 bushels; Bangor, Me., 291,288 bushels; Memphremagog, Vt., 24,802 bushels; Boston and Charlestown, Mass., 361,658 bushels; New York, N. Y., 5,232,514 bushels; Philadelphia, Pa., 1,299,480 bushels; Baltimore, Md., 379,510 bushels; Newport News, Va., 47,994 bushels; Buffalo, N. Y., 77,442 bushels; Niagara Falls, N. Y., 13,897 bushels; Huron, Mich., 194,845 bushels; Detroit, Mich., 177,788 bushels; Arizona, 43,993 bushels; and Porto Rico, 23,397 bushels. Smaller importations were received in the following States: New Jersey, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Ohio, Wisconsin, Illinois, Minnesota, North Dakota, South Dakota, Missouri, Montana, Idaho, Washington, Oregon, California; and in the Territories of Alaska and Hawaii, 49,267 bushels. Total, 8,383,966 bushels.[1]

Since this country has no legislation which can in any way prohibit the importation of infected potatoes, seed which Canada and other foreign countries will not accept can be shipped at will into the United States. On account of our nearness and lack of quarantine regulations there is no question but that Newfoundland will ship her potatoes here which are now refused in Canada. Some legislation in regard to the wart disease should be enacted whereby the Secretary of Agriculture would have absolute control of all importations of potatoes.

PRESENT METHOD OF INSPECTION FOR INSECTS ENTIRELY INADEQUATE WHEN APPLIED TO FUNGOUS PLANT DISEASES.

The present system of inspecting imported nursery stock for noxious insects may be briefly outlined as follows: Customhouse officers send to the Entomologist of the United States Department of Agriculture a daily report of importations of nursery stock covering the following items, among others: (1) Consignor, (2) consignee, (3) kind of stock, (4) number of packages, etc. Each of these statements may be either indefinite or erroneous. Under "consignor" may be given the name of a European agent, whereas the information really wanted is the name of the nursery from which the stock originated. Under "consignee" is very often found merely the name of an agent or broker, with no information as to the

[1] Information furnished by the Bureau of Statistics, United States Department of Agriculture.

true destination of the stock. The "kind of stock" may be so indefinitely worded that practically no information is given; it should give the specific name of each kind of stock. The statement as to the number of packages may be exceedingly indefinite as to the actual quantity of trees. The exact number should be given in round numbers at least.

Even with these statements in hand it is impossible in many cases to tell what shipments contain a certain suspected kind of plant, from what nursery or person they came, or to whom and where they are ultimately going, all of which information is necessary in order to decide whether inspection is needed and to notify the proper inspection authorities so that they may make the inspection if necessary. Besides the notice from the customhouse, the railroads send in notices of lots forwarded by them. Upon receipt of these statements the entomologist informs the inspectors of each State about the stock needing inspection which is on its way to that State. This procedure works fairly well for insect pests but is far from perfect in the actual results obtained. See Farmers' Bulletin 453, entitled "Danger of General Spread of the Gipsy and Brown-Tail Moths through Imported Nursery Stock," by C. L. Marlatt, for statements regarding this.

For the detection of dangerous fungous plant diseases this method is exceedingly defective and inefficient and causes the useless expenditure of much money and time in tracing uncertain importations. The past two springs the Office of Investigations in Forest Pathology has sent notices to the State inspectors concerning all imported lots of white pines, but it is very doubtful whether all, or even the greater part, of the importations were known. A very radical change is needed to make the inspection service for plant diseases as efficient as it should be. A permit system appears to be the only adequate method of obtaining the information which is absolutely necessary in order to cope intelligently with the situation.

At present pathologists of the United States Department of Agriculture have absolutely no power with regard to diseased stock in any State or Territory; hence, State officials must handle the inspection and take such measures as their laws indicate. The States vary much in the efficiency and execution of their inspection laws, the protection afforded ranging from practically none to fairly good. Even in the best protected States it is not uncommon to find imported nursery stock which has reached the State without the knowledge of the inspector. In the other States it is very common for such lots to gain entry entirely unknown to the proper authorities. Besides all this, the State laws apply only to plants raised within or shipped from outside to some point within the State and then unpacked and planted out; that is to say, any amount of stock may be imported

and shipped again to other States without being required to pass any inspection. In nearly all States the imported stock may even be repacked into smaller lots before being reshipped. The next State receiving such stock receives it under the assumption that it was raised in the former State, and it is inspected or not as the laws of the latter and the efficiency of its inspection service may determine.

It is quite a general custom among nurserymen handling ornamental stock to import their supply of 1-year-old evergreens. The cost is small and this procedure saves annoyance and the bother of handling seed beds of their own. It is also not uncommon for these nurserymen to buy older stock and fill their orders with it. The ornamental trade usually calls for small lots of each species used, thus giving a maximum distribution to diseased trees. In this way a lot of 50,000 trees might very easily be sent to hundreds of different places throughout the country. Furthermore, in such cases it is impossible to trace all such trees to their final destination, and it is exceedingly difficult to learn of the importations so that they can be inspected before being distributed to the planters.

Besides the nurserymen handling ornamental stock, there is an increasingly large number of private persons who import directly for their own use, in lots of five thousand to several hundred thousand. These are especially hard to find.

A third class of importers is the brokers who handle only large lots; these import simply, and sell their stock to nurserymen or to private individuals in lots ranging from one thousand to hundreds of thousands. The broker's transactions in many cases do not come under the State laws and much of their stock is never inspected. For instance, a lot of trees is received by a New York broker at the Hoboken wharves; he immediately sends some of it to a Middle Atlantic State. That stock is not inspected by the New Jersey inspectors, as its destination is another State and it is not unpacked in New Jersey. When received at its destination, the shipment is either planted out in the nursery or is again split up and forwarded to still other localities, partly in other States, where it finally is planted out. In each shipment of the lot from one State to another no inspection is made by the State from which the shipment is made, and if the laws or inspection are defective for any reason in the State receiving the shipment the diseased trees may run the entire gamut without ever passing under an inspector's eye. Many such cases occur each spring.

There are very few of the State inspection laws which cover anything but nursery stock and orchards. A few have passed laws which apply to plants and parts of plants of all kinds. At present there is no inspection of potatoes, and hence the wart disease will

surely enter the country, if it has not already done so. It will inevtably take several years for all the States to pass inspection laws for potatoes, and meantime the wart disease will surely become established. Even then the disease often is in such a state that inspectors can not detect it. Hence, it is of the greatest importance that adequate national power be given to regulate importations of white pines and potatoes.

The laws of most States apply only to insects and in some cases to a few specific fungous diseases. Only very few have a law which permits action against new diseases, such as the white-pine blister rust or the potato wart disease. Moreover, the State inspectors are educated entirely for the detection of insects, while very few have the training and experience necessary for the detection of fungous diseases. All the States should extend the possible powers of their horticultural inspectors, especially so that quick action may be taken with dangerous new diseases. Moreover, the various States should as soon as possible get competent plant pathologists especially for inspection work, who shall cooperate with the present horticultural and entomological inspectors. These men should be given legal authority and sufficient appropriations so that they can do thorough work.

SUMMARY.

The white-pine blister rust and the potato wart, two plant diseases which have caused great damage in Europe, are being brought into America regardless of the danger of their becoming permanently established in this country. They can not be efficiently handled by inspection. If they once become established here they are practically sure to have a disastrous effect, the former upon the growth of white pine and of other closely related pines which are among our most valuable timber trees and the latter upon the cultivation of one of our greatest food crops, the potato.

The only practical method of dealing with these two diseases is that of total prohibition of the importation of white pines and potatoes from certain localities. This can be secured by giving the Secretary of Agriculture quarantine power in connection with dangerous fungous diseases similar to that he now has for animal diseases. This power should be accompanied by a permit system for all plant importations, as only in this way can information concerning all importations be obtained. These ends can not be secured in any other way. Moreover, these measures must be made effective at once or the only opportunity for preventing these two diseases from becoming permanently established here will be lost.

489

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